CRWMS/M&O

Design Analysis Cover Sheet

Complete only applicable items.

(1.)

WBS: 1.2.6

QA: ~~QA~~ N/A 03/28/95

Page: 1 Of: 10

2. DESIGN ANALYSIS TITLE		
COMPRESSED AIR SYSTEM/CONDENSATE RECEIVER TANK FOUNDATIONS		
3. DOCUMENT IDENTIFIER	4. REV. NO.	5. TOTAL PAGES
BABBDF000-01717-0200-00001 REV 00	00	10
6. TOTAL ATTACHMENTS/NO. OF PAGES IN EACH	7. SYSTEM ELEMENT	
NONE	ESF	

	Print Name	Signature	Date
8. Originator	M. Gomez		01/17/95
9. Checker	J. Salchak		01/18/95
10. Lead Discipline Engineer	M. Gomez		01/18/95
11. Department Manager	J. Salchak		01/18/95

12. REMARKS

CRWMS/M&O

Design Analysis Revision Record

Complete only applicable items.

(1.)

WBS: 1.2.6.1

QA: ~~QA~~ 0/1 03/28/95

2. DESIGN ANALYSIS TITLE	
COMPRESSED AIR SYSTEM/CONDENSATE RECEIVER TANK FOUNDATIONS	
3. DOCUMENT IDENTIFIER	4. REVISION NO.
BABBDF000-01717-0200-00001 REV 00	00

5. Revision No.	6. Pages Added	7. Pages Deleted	8. Description of Revision
00	10	0	Original Issue

1. PURPOSE

The purpose of this analysis is to design structural foundations for the Compressed Air System (CAS), and the Condensate Receiver Tank. This analysis is in support of design drawing BABBDF00-01717-2100-23017.

2. QUALITY ASSURANCE

The items considered within this analysis relate to temporary equipment foundations not included on the Q-list. There are no Q-Controls associated with this analysis.

3. METHOD

The equipment foundation shall be designed in Section 10 using standard foundation design hand calculations. The vertical loads will reflect Mechanical requirements. Lateral loads will be calculated using applicable codes. The soil bearing and foundation stresses will be analyzed using accepted engineering mechanics. The foundation will be designed using the Strength Design Method.

4. CODES AND STANDARDS

4.1 U.S. DEPARTMENT OF ENERGY (DOE):

DOE 6430.1A, dated April 6, 1989	General Design Criteria

4.2 AMERICAN CONCRETE INSTITUTE (ACI):

ACI 318-89	Building Code Requirements for Reinforced Concrete

4.3 AMERICAN NATIONAL STANDARDS INSTITUTE, INC./AMERICAN SOCIETY OF CIVIL ENGINEERS (ANSI/ASCE):

ANSI/ASCE 7-88	Minimum Design Loads for Buildings and Other Structures

4.4 UNIFORM BUILDING CODE (UBC):

UBC, 1991

4.5 AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC):

AISC, 9th Edition	Manual of Steel Construction, Allowable Stress Design

4.6 AMERICAN WELDING SOCIETY (AWS)

AWS D1.1-94 Structural Welding Code-Steel

5. DESIGN INPUTS

5.1 Exploratory Studies Facility (ESF) Basis for Design (BFD) Document, Package 1D, Section 7.2.4.6 Surface Compressed Air System (BAB000000-01717-6300-00002, Rev. 05)

6. CRITERIA

6.1 The Exploratory Studies Facility Design Requirements (ESFDR) (YMP/CM-0019, Rev. 1)

6.2 ESF BFD Document, Package 1D (BAB000000-01717-6300-00002, Rev. 05)

6.3 Determination of Importance Evaluation for ESF North Portal Pad (BABB00000-01717-0200-0000 Rev. 04)

7. ASSUMPTIONS

None used.

8. REFERENCES

8.1 Geotechnical Recommendations for Design, North Ramp Surface Facility, Exploratory Studies Facility, Yucca Mountain Project, Nevada, SCP No. 8.3.1.14.2. (March 19, 1993)

9. COMPUTER PROGRAMS

None used.

10. DESIGN ANALYSIS

10.1 This analysis was initially performed under Revision 0, ICN 1 of the ESFDR, with Seismic Zone 4. Revision 0, ICN 2 of the ESFDR revised the lowered criteria to Seismic Zone 3. The initial design is conservative, with foundation sizes based on physical requirements. Therefore, the analysis will reflect the higher criteria of Zone 4.

10.2 Allowable Soil Pressure = 2,000 psf (See Reference 8.1)

10.3 Passive Soil Pressure = 350 psf per foot of depth (See Reference 8.1)

10.4 Concrete Properties

A. Compressive Strength (f'c) = 4,000 psi
B. Concrete weight = 150 pcf

10.5 Reinforcing Steel Yield Strength (fy) = 60 ksi

(Reference pages 6, 7, 8, and 9 for hand calculations)

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
Civilian Radioactive Waste Management System
Management & Operating Contractor

CONTRACT NO. DE-AC01-91RW00134
SUBJECT: COMPRESSED AIR SYSTEM/CONDENSATE RECEIVING TANK FDN.

WBS NO: 1.2.6.
DATE: 7-6-94 REV NO:
CALC NO: BABBDF000-01717-0200-00001
ORIGINATOR: M. GOMEZ
CHECKED BY:
CHECKED DATE:

10. DESIGN ANALYSIS (CONT'D):

10.6 COMPRESSED AIR PAD

- WEIGHTS

EQUIPMENT TYPE		WT	6 UNITS TOTAL (3 INSTALLED/3 FUTURE)
AFTER COOLER	(AX)	1600#	
MOISTURE SEPERATOR	(MS)	200#	
RECEIVER	(VE)	8,000#	
FILTER	(FL)	500#	
AIR COMPRESSOR	(CM)	10,000#	
		20,300#/UNIT	

* WEIGHTS ARE RELATIVELY UNIFORM ACCROSS PAD. INCREASE 50% FOR ECCENTRICITY & PIPING

WT = 20.3K(1.5) = 30.5K

- LATERAL FORCES: $F = q_z G_h C_f A_f$ (ANSI/ASCE 7-88)

$q_z = .0025(K_z)(I V^2)$
$= 15 psf$

$F = 15(1.32)(1.4)(A_f)$
$= 27.7 A_f$

* $A_f = 8'(50') = 400\#$

$F = 27.7(400) = 11.1K$

$K_z = 0.8$ 0-15'
$I = 1.01$ (CAT. III)
$V = 80 mph$
$G_h = 1.32$ <15'
$C_f = 1.4$ *

* ASSUME EQUIVALENT FLAT PROJECTED AREA

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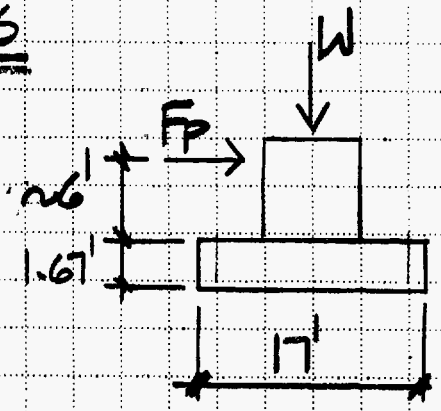
(UBC CHAPTER 23)
Z=.4 ZONE 4
I=1.5
C_p=.75 TABLE 23P III.1

B.) SEISMIC: $F_p = ZIC_pW_p$
$= .45W_p$

$F_p = .45(30.5) = 13.7^k$

∴ SEISMIC GOVERNS



- OVERTURNING:

ASSUME F_p ACTS AT 2/3h

FOUNDATION SIZE = 17' × 55' × 1'-8"

$F_p = 13.7^k$

$W_T = 30.5^k + (17'(55)(1.67')(.15)$
$= 265^k$

* DESIGN MAT FOR TRIBUTARY WIDTH (CONSERVATIVE)

$M_{OT} = 13.7^k(8') = 110^{ft\text{-}k}$

$M_R = 265^k(17'/2) = 2255^{ft\text{-}k}$

STABILITY RATIO = 2255/110 = 20.5 OK

- SOIL BEARING

$e = M/P = 110/265 = .42' < L/6 = 17'/6 = 2.83'$

$S.B. = \frac{P}{A}\left[\pm \frac{6e}{L}\right] = \frac{265}{17'(55)}\left[\pm \frac{6(.42)}{17'}\right]$

$S.B. = 320 psf < 1.33(2000) = 2661 psf$ OK
MAX USE 500 psf (CONSERVATIVE)

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- REINFORCING: MAXIMUM CANTILEVER = 6'

$w_{u\,max} = 1.1(1.7)(.75)(500) = 700\,psf$

$M_u = .7(6)^2/2 = 12.6^{k}$

$K_u = \frac{12.6^{k}(12000)}{12(16.5)^2} = 46$

d: 20" - 3" - .5" = 16.5"

$\rho = 1.33(.0013) = .0017$ ← GOVERNS

(OR) $\rho = .0035$

$A_s = .0017(12)(16.5) = .34\,in^2/1'$

USE #7 @ 12" ℄ E.W.

$A_s = 0.6\,in^2/1'$

10.2 CONDENSATE RECEIVING UNIT FDN:

- WEIGHT EMPTY = 9200#
  FULL = 12500#

- SIZE 4'-6" ϕ x 13'-0" LONG

- LATERAL FORCES

A.) WIND: SIMILAR TO 10.1 EXCEPT $C_F = 0.6$ TABLE 12

$q_z = 15\,psf$

$L/D = 13'/4.5' = 2.9$

$D\sqrt{q_z} = 17.4 > 2.5$

$F = 15(1.32)(.6)A_f$
$= 11.9A_f = 11.9(58.5)$
$F = 700^{\#}$

$A_f = 4.5'(13') = 58.5^{\square'}$

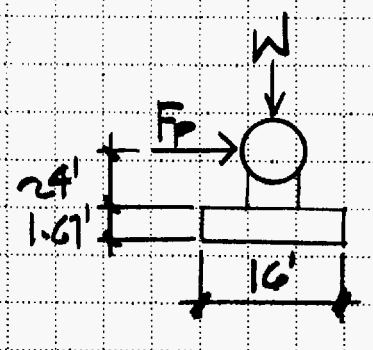
B) SEISMIC: SIMILAR TO SECTION 10.1

$F_p = .45(12.5^k) = 5,625^{\#}$

∴ SEISMIC GOVERNS

- OVERTURNING:

FOUNDATION SIZE = 16' × 21' × 1'-8"



$F_p = 5.63^k$

$W_T = 12.5^k + 16'(21')(1.67')(.15) = 97^k$

$M_{OT} = 5.63^k(6') = 33.8^{kft}$

$M_R = 97^k(16'/2) = 776^{kft}$

STABILITY RATIO: $776/34 = 22.8$ OK

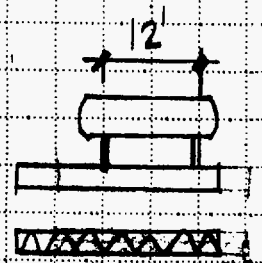
- SOIL BEARING

$e = M/P = 33.8/97 = .35' < L/6 = 16'/6 = 2.67'$

$S.B. = \frac{P}{A}\left[1 \pm \frac{6e}{L}\right] = \frac{97^k}{16'(21')}\left[1 \pm \frac{6(35)}{16}\right]$

$= 300^{psf}_{MAX} < 1.33(2000) = 2661\ psf$ OK

- REINFORCING:



$w_{u\,MAX} = 1.4(300) = 420\ psf$

$M_u = .42(9)^2/2 = 17^{kft}$; $K_u = \frac{17(12000)}{12(16.5)^2} = .63$

$\rho = 1.33(.0013) = .0018 < \rho_{GN}$

(OR) $\rho = .0033$

$A_s = .0018(12)(16.5) = .36\ in^2/'$

USE #7@12"c/c E.W. ($A_s = .60\ in^2/'$)

$d = 20" - 3" - .5" = 16.5"$

11. CONCLUSIONS

11.1 The design shows that a concrete foundation that has minimum dimensions of 17' x 55' x 1'-8" thick, reinforced with #7 bars @ 12" o/c each way, is adequate to support the CAS equipment.

11.2 The design shows that a concrete foundation that has minimum dimensions of 16' x 21' x 1'-8" thick, reinforced with #7 bars @ 12" o/c each way, is adequate to support the Condensate Receiver Tank.

12. ATTACHMENTS

None